REMARKS

Applicants traverse the rejection of claims 38-44 under 35 USC 103(a) as being unpatentable over Chao et al. US Patent Publication 2002/0106845. Despite the allegations in the Office Action, Chao et al. does not show the invention substantially as claimed.

The Office Action relies on paragraphs 0048 and 0049, and Figure 4D of Chao et al. to disclose changing the power applied to the etchant plasma while the rounded corner is being formed. The examiner then admits the reference does not expressly disclose the requirement of independent claim 42 to gradually change the power applied to the etchant plasma while the rounded corner is being formed. She states it would have been obvious to one of ordinary skill in art, through routine experimentation, to determine the manner in which the power is changed.

Paragraphs 0048 and 0049, as well as paragraph 0050 that go into detail about the bottom-corner-rounding etch process, indicates there is no disclosure in Chao et al. of changing power while the corner is being formed. The last sentence of paragraph 0049 is the only relevant portion of paragraphs 0048 and 0049 that mentions power. The last sentence of paragraph 0049 merely states there is an increase in the power of source 105 that drives antenna 102 to increase the amount of rounding occurring at the bottom corners. This statement does not say the power of source 105 increases while

the corner is being formed. A reasonable interpretation of this statement is that the power of source 105 increases prior to the corner being formed.

Paragraph 0050 indicates power supply 105 supplies 300 W of RF power to antenna 102 to ignite the plasma. The reference then goes on to say the source power is lowered to increase the etch uniformity, and that the reduced source power decreases etch rate. The reference also indicates the RF bias power supplied by source 106 to pedestal 107 is reduced to minimize high-speed ion bombardment against substrate 110. Based on the foregoing, there is nothing in any of paragraphs 0048-0050 to indicate power supplied to the etchant plasma is changed while the rounded corner is being formed.

The Tables in paragraphs 0054 and 0055 indicate the power applied by source 105 to antenna 102 during bottom-corner-rounding can be anywhere between 200 to 1500 W. This does not mean the power is changed during bottom corner rounding, but merely states the power applied to antenna 102 can be within this range during the entire time while the bottom corner rounding occurs.

Based on the foregoing, Chao et al. does not disclose the requirement of independent claim 42 for gradual changes in the power supply to the etchant plasma to occur while a rounded corner is being formed. Further, as pointed out in the application as filed, the requirement for the time for the plasma to remain constant for durations not

in excess of one second is an important limitation in forming a rounded corner, as pointed out on page 6, first full paragraph of the application as filed. It is there indicated that steps lasting longer than about one second do not have adequate temporal resolution to achieve the desired workpiece shapes.

Chao et al. indicates a soft etch is applied to the workpiece after the bottom corner rounding has been completed because the soft etch removes damaged outer surfaces without significantly altering the trench profile or worsening the sidewalk roughness; see paragraph 0056. Applicants' claimed method enables rounded corners to be formed without such damage. In this regard, see the attached Declaration of Thomas A. Kamp.

The allegation in the office action that it would have been obvious to one of ordinary skill in the art at the time applicants' invention was made to determine, through routine experimentation, the manner in which the power changes and whether the pressure, flow rate or species flowing into the chamber is constant or changed based on a variety of factors including the desired profile of the corner and such limitations would not lend patentability to the instant application, absent a showing of unexpected results, has no basis in law or fact. To establish a *prima facie* case of obviousness of the claimed invention, all the claimed limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981, 180 USPQ 580 (CCPA 1974); MPEP Section 2143.03. Since the Examiner impliedly admits Chao et al. does not disclose the requirements for

the flow rate and species flowing into the chamber to be constant, the Examiner has failed to establish the requirements for a prima facie case of obviousness.

The importance of maintaining the flow rate and species flowing into the chamber constant is discussed in the application as filed in the only full paragraph on page 3. It is there indicated that there are disadvantages in transiently adding dilutants and/or passivation gases. Because of the relatively large volume of a typical plasma processing chamber, a significant amount of time, up to 10 seconds, is required to purge "old" gas from a line coupling gas from a gas source into a chamber. As result, there are substantial increases in workpiece processing time, to reduce efficiency and decrease workpiece throughput. In addition, changing the gas species on a transient basis results in a change in plasma impedance. The plasma impedance change adversely affects the ability of a matching network between an electric source and a coil and/or electrode to provide an efficient transfer of power between electric source or sources and the driven loads in the processing chamber. In addition, the time required for a new gas, that is, the dilutant or passivation gas, to flow into the chamber is likely to vary as a function of gas line length between the chamber and the gas source. As a result, precise control of the processing step is difficult to achieve and/or recipe processing steps must be customized for different gas line lengths between the different gas sources and the chamber. Based on the foregoing, the allegations in the office action concerning maintaining the flow rate and species flowing into the chamber constant while power supplied to the plasma is gradually changed to form a rounded

corner are wrong.

The office action fails to consider the limitations of claims 40 and 41. Hence, no attempt has been made to establish a *prima facie* case of obviousness with regard to claims 40 and/or 41.

To provide applicants with the protection to which they are deemed entitled, claims 45-66 are added. Claim 45 includes the constant pressure feature formerly in claim 42. This feature is important for reasons similar to the constant species and constant flow rate features. Claim 46 indicates an electric source that supplies gradually changing power to the etchant plasma has steps with a maximum change of less than 5% of the source maxima output power. This feature is disclosed, *inter alia*, in the first full paragraph on page 6 of the application as filed.

New independent claims 47 and 59 are similar to previously submitted independent claims 1 and 17, respectively. The claims dependent upon claims 47 and 59 are similar to claims that were previously dependent on claims 1 and 17. Claims 1 and 17 and the claims previously dependent thereon were canceled in the last response solely to expedite prosecution of this application since the previous office action indicated claims 38-44 were allowable. Because the allowability of claims 38-44 has been withdrawn based on a reference that does not render any of these claims obvious, applicants have decided to pursue the broader coverage provided by claims 47 and 59.

A slight difference between claims 47 and 59 *vis-à-vis* claims 1 and 17 is that the terminology "feature" has been changed to "desired shape." Clearly, the rounded edges or corners 216, Figure 6, that are formed in accordance with the process set forth in the paragraph bridging pages 16 and 17 of the specification qualify as structures having "desired shapes." Also page 6, line 14 of the application refers to "desired workpiece shape."

With regard to the requirements of claims 47 and 59 for the AC etchant plasma always to be the dominant material applied to the workpiece while the desired shape is being formed, applicants' specification makes frequent reference to the fact that the plasma etches the material. Page 16, line 23-page 17, line 2 states microprocessor 201 has a memory system that performs a final etch operation for 15 seconds. The final etch operation causes formation of a predetermined shape, for example, a rounded edge 216 between point 212 and base 214. During a 15 second final etch operation a suitable mixture of HBr/O_2 constantly flows from source 68 into chamber 40 while the power that amplifier 132 supplies to electrode 56 gradually changes from 200 W to 100 W in 15,000 steps, each having a duration of 1 ms and an amplitude of 6.667 milliwatts. As pointed out in the accompanying Declaration of Andrew D. Bailey, Ph.D., one of ordinary skill in the art would interpret such a statement to mean that the etchant HBr is always dominant over the O_2 passivation gas because the memory system is stated to perform the final etch operation. Dr. Bailey has testified that one of ordinary skill in the art knows that if the etchant gas HBr and the passivation gas O_2 both constantly flow to

a chamber to perform an etch operation, that the etchant gas HBr must always be dominant over the passivation gas O_2. Otherwise, the material in the passivation gas would be deposited on the workpiece and etching would not occur. Based on the foregoing, claims 47 and 59 satisfy the requirements of 35 USC 112, paragraph 1.

Claims 47 and 59 distinguish over Chao et al. because Chao et al. does not disclose gradually changing, on a pre-programmed basis, the amount of AC power supplied to a plasma during etching of the workpiece to form a desired shape, wherein a gradual transition in the shape of material that has the desired shape and the workpiece being processed occurs in response to the gradual power change, and wherein the gradual power change occurs during the gradual transition in the shape of the material that has the desired shape. As previously discussed, in connection with the rejection of claims 38-44, Chao et al. does not disclose gradually changing the amount of AC power supplied to a plasma during etching of a workpiece to form a desired shape.

Claims 47 and 59 distinguish over Bhardwaj et al, US patent 6,051,503, and Howald et al., WO 00/58992, because neither reference discloses an AC etchant plasma that is always the dominant material applied to a workpiece while a desired shape is being formed. In Bhardwaj et al., the desired shape is a wall of a trench, not a portion of a wall of a trench. To form a wall of a trench, Bhardwaj et al. alternately supplies etchant gas and passivation gas to the chamber. In addition, the waveforms of Figure 9 (i) and 9 (ii) indicate power changes abruptly between the etch and deposition

steps. The RF bias is high during the deposition steps when pressure is low, and is low during the etch steps when pressure is high. These alternate etch and deposition steps occur to form a desired shape, particularly a side wall, as discussed in column 1, lines 4-13 and as set forth in the independent claims of Bhardwaj et al.; see Paragraph 4(b) of the Bailey Declaration.

The comment in the last sentence in the paragraph bridging pages 3 and 4 of the September 18, 2006, office action is complete nonsense. The sentence is: "Note that inherently a gradual power change will also produce a rounded profile in Bhardwaj et al. since a gradual power change in the instant application similarly produces a rounded profile." Applicants' application, at page 16, line 23-page 17, line 4, indicates rounded edges 216 between point 212 and base 214 are achieved in the preferred embodiment, during a final etch operation, by gradually decreasing the power that amplifier 132 supplies to electrode 56 in 15,000 steps, each having a duration of 1.0 ms and an amplitude of 6.667 milliwatts. Because Bhardwaj et al. has no disclosure of forming a rounded profile, the Examiner's rationale is completely without foundation. Further, the Examiner has the burden of proving inherency. No adequate attempt has been made to show that Bhardwaj et al. forms a rounded profile.

Claim 50 indicates the material is shaped to have a curved surface and claim 51 indicates a trench wall including a rounded corner is included in the desired shape. Claim 52 requires a rounded corner to be at an intersection of a wall and a base of a

trench, while claim 53 indicates a rounded corner is at an intersection of the wall and a surface intersecting the wall, wherein the surface extends generally at right angles to the wall.

The allegation in the September 18, 2006 office action that the abstract and column 6, lines 43-49 of Bhardwaj et al. disclose these features of claims 50-53 is incorrect. The abstract indicates a trench is formed, with no mention of curved surfaces or corners, no less rounded corners. Column 6, lines 43- 49 indicates parameters are ramped with no discussion of curved surfaces or rounded corners. The implication is that the Bhardwaj et al. wall is desirably straight as a result of the ramping because the notch of the prior art is reduced or eliminated.

Claims 54 and 55 specify time and wattage parameters applicants have found are important in providing the desired shape. The first full paragraph on page 6 of the specification indicates the importance of the temporal and power step limitations to achieve the desired workpiece shapes.

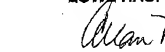
Limitations similar to those of claims 50-55 are included in claims dependent on claim 59.

In view of the foregoing amendments and remarks, allowance is in order.

To the extent necessary, a petition for an extension of time under 37 C.F.R. 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account 07-1337 and please credit any excess fees to such deposit account.

Respectfully submitted,

LOWE HAUPTMAN & BERNER, LLP



Allan M. Lowe
Registration No. 19,641

1700 Diagonal Road, Suite 300
Alexandria, Virginia 22314
(703) 684-1111
(703) 518-5499 Facsimile
Date: May 24, 2007
AML/mps/cjf